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/			Maria de la compansión			
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Annex

EXPLANATIONS AND EVALUATIONS OF ALTERNATIVE PLANS FOR SHARING OIL IN EMERGENCIES

Overview

Each of the seven plans 1/ considered in 1973 by the Informal Group on Sharing of the OECD Oil Committee could affect oil prices and trade flows. The plans differ only in how oil supplies are to be allocated during crises. To the extent that any sharing plan succeeds, oil prices during an emergency would not be increased by a scramble for available supplies.

In comparing the plans against the alternative of no agreement on sharing, we omit price effects and political considerations, and focus only on differences in allocations during emergencies. Table 1 provides a brief explanation and evaluation of each plan. In subsequent sections and

1/ The plans are stated in the report Apportionment of Oil Supplies in an Emergency Among the OECD Member Countries (Paris, 19 November 1973). Distribution of the report was limited to the High Level Group of the OECD Oil Committee.

Table 1

Summary Explanations and Evaluations of Alternative Plans for Sharing Oil in Emergencies 1/

Disadvantages to the US Advantages to the US Description Plan Name The parameters proposed by the French imply that their oil imports are much Parameters of the plan could in principle be adjusted so that A complex plan proposed by French delegates to the Vital Noeds more important than ours. Under this assumption, the USuld fare much during virtually all crises we could import more oil with the Informal Group. better without an agreement to share. agreement than without it. In some cases we might be required to forgo all oil imports. In most embargoes directed not just against During certain crises, we could import more oil with the agreement than without it. During a crisis, each partner country takes an equal percentage cut in Consumption-Based Sharing the US, we could import more oil under oil consumption. no agreement to share. Unknown. This plan is essentially undefined. The Group noted Unknown. Consumption-Based Sharing, with Bonuses for Domestic Prothat in some cases it would be almost impossible to specify what the bonus duction would be, and who would get In relation to potential US cuts in incil consumption implied by import-based sharing, the corresponding cuts for Western Europe and Japan could well be In all crises, this plan would allow us to import more oil than would consumption-During a crisis, each partner country takes an Import-Based Sharing equal percentage cut in During the most based sharing. oil imports. so harsh that these nations would not adhere to the agreement. likely embargoes, we would fare better under import-based

/ The plans are considered in the order listed in the Informal Group's report, ibid.

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sharing than under no agreement.

Table 1 (continued)

Plan Name

Arithmetic Compromise Between Import-Based Sharing and Consumption-Based Sharing

Combination of Import-Based Sharing, Essential Needs Sharing, and Consumption-Based Sharing

Sharing on an Import
Basis, but with a Limit
on Differences in
Fercentage Cuts in
Consumption

Description

Import-based sharing implies one set of shares during a crisis, and consumption-based sharing implies another set of shares. An arithmetic compromise is simply a weighted average of the two alternative solutions.

The paritcular combination suggested in the Group's report differs negligibly from consumption-based sharing.

When the limit is zero, all partner countries take the same percentage cut in consumption, so in this case the plan reduces to consumption-based sharing. With a limit of 100 percentage points, the plan becomes import-based sharing. Between these extremes, the limit makes import-based sharing more acceptable to Western Europe and Japan.

Advantages to the US

To the extent that the importbased solution is weighted heavily, we would do well.

If import-based sharing were weighted much more heavily in the combination, then the plan might be preferable to no agreement.

Introduction of a limit on consumption cuts makes conceivable an import-based agreement with Western Europe and Japan.

Disadvantages to the US

To the extent that the consumptionbased solution is weighted heavily, we could import more oil under no agreement to share.

The combination suggested in the Group's report has essentially the disadvantages of consumption-based sharing.

If the limit is less than five percentage points, the agreement has the disadvantages of consumption based sharing.

and tables, the plans are illustrated in detail with numerical examples. Finally, the effects of seven plans in different possible crises are presented.

Numerical Examples

Six of the seven plans are illustrated in the order listed in the Group's report. One plan, namely consumption-based sharing with bonuses for domestic production, is not illustrated because the Group noted that in some cases it would be almost impossible to specify what the bonuses would be and who would get them.

The Vital-Needs Plan

We illustrate this plan with three examples in table 2. In all cases the plan transforms an initial set of losses--shown in the first column of each table--into a final solution shown in the last column of each table. The plan transforms the initial position differently depending on whether a crisis is severe, moderate, or mild. Example I illustrates a severe crisis defined as a case where priority needs exceed available supplies:

Table 2

Example I

Vital Needs Shares During an All-Aral Boycott of the US and Western Europe in 1975
(All quantities in millions of barrels per day unless otherwise stated)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
	Initial Loss	Oil Consumption	Priority Factors	Priority Needs	Oil Available	Shares of Total Priority	Distribution of Total Available Oil	Loss After Distribution	
United States Western Europe Japan	3.4 11.2 	19.0 17.0 6.6	61.0% 72.1% 81.5%	11.6 12.2 5.4	15.6 5.8 6.6	39.7% 41.7% 18.5%	11.1 11.7 5.2	7.9 5.3 <u>1.4</u>	
Total	14.6	42.6		29.2	28.0		28.0	14.6	

Total		14.0	<u>6</u> <u>42</u>	<u>. 6</u>		29.2	28.0	•	2	8.0	14.6	G 2
<u>ක</u> ක												y i Thanki I o se apal E I I i i i i E I i i i i i i i i i i i i i i i i i i
war, s wayara wagang		•	•		Ex	cample II	•					Produced Fr. 6 feat 6 - 75 apr 12 feat
E.7.7	•	Vital Needs Sh	nares Durin	g an Iran	/Iraq Cut-	off of the	US, Wester	n Europe	and Japan	in 1975	• •	,
and a	(1)	(2)	(3)	(4)	(5)	(6)	(7) Excess	(8)	(9)	(10) Loss Dis-	(1	.1) "" "
,	Initial Loss	Oil Consumption	Priority Factors	Priority Needs	Non- Priority Needs	Priority Losa	Over Priority Needs	Allo- cation of Loss	Loss After Adjustment	tributed by Non-Priority Needs		ss After justment
United States		10.4	C1 04		- 4					_		

United States 61.0% 72.1% 81.5% 11.6 12.2 5.4 6.3 1.3 <u>0.0</u> 3.92 2.54 <u>.64</u> 3.06 3.12 <u>.92</u> Western Europe Japan -1.3 42.6 Total <u>7.1</u> 29.2 7.6 0.0 13.4 7.1 7.10 7.10

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Table 2 (continued)

Example III

All Arab Embargo of the US Alone in 1975
(All quantities in millions of barrels per day unless otherwise stated.)

	(1)	(2)	(3)	(4)	(5)	(6) Allocation	(7)	(8)
	Initial Loss	Oil Consumption	Priority Factors	Priority Needs	Non- Priority Needs	of Loss by Non-Priority Needs	Loss Adjustments	Loss After Adjustment
United States Western Europe Japan	3.4 0.0 0.0	19.0 17.0 6.6	61.0% 72.1% 81.5%	11.6 12.2 5.4	7.4 4.8 1.2	1.9 1.2 <u>.3</u>	1.7 .95 0.0 .60 0.0 .15	2.65 .60 .15
Total CTO CTO U.M.	3.4	42.6		29.2	13.4	3.4	1.7 1.70	3.40
Maria grandi Protesta		•	E	cample IIIa	1			•
tru Tar		<u> A11</u>	Arab Embaro	o of the U	S Alone in	1975		•
67 - 159 Mr. 1553 स्कारकर्षी Mr. 1564	(1)	(2)	(3)	(4)	(5)	(6) Allocation	(7)	(8)
	Initial Loss	Oil Consumption	Priority Factors	Priority Needs	Non- Priority Needs	of Loss by Non-Priority Needs	Loss Adjustments	Loss Adjustment
United States Western Europe Japan	3.4 0.0 0.0	19.0 17.0 <u>6.6</u>	61.0% 72.1% 81.5%	11.6 12.2 5.4	7.4 4.8 1.2	1.9 1.2 <u>.3</u>	2.99 .285 0.00 .180 0.00 .045	3.175 .180 <u>.045</u>
Total	3.4	42.6		29.2	13.4	3.4	2.89 .510	3.400

- -- columns (1) and (2) are initial losses and levels of consumption;
- -- column (3) lists priority factors suggested by the French;
- -- priority needs in column (4) come from multiplying each item in (2) times the corresponding priority factor in (3);
- -- available oil supplies in column (5) are (2) minus (1);
- -- percentage shares of total priority in column (6) are derived by dividing the total of (4) into each element of (4);
- -- the shares of total available oil in column

 (7) are the total of (5) times the percentages
 in (6); and
- -- The final solutions in column (8) are derived by subtracting the oil available in (7) from the oil consumption figures in (2).

A moderate crisis occurs when enough oil is available to meet total priority needs, but at least one partner's initial loss exceeds his non-priority needs. Computations in the moderate crisis illustrated by Example II are:

- -- priority needs in column (4) are derived by multiplying each priority factor in (3) by the corresponding level of consumption in (2);
- -- non-priority needs in column (5) are (2) minus (4);
- -- a priority loss in column (6) is any negative value obtained by subtracting (1) from (5);
- -- excesses over priority needs in column (7)

 are positive values obtained by subtracting (1)

 from (5);
- -- the total shortfall in priority needs, which is the sum of column (6), is allocated in (8) by dividing the total of (7) into each element of (7), and then multiplying the results by the priority loss--in this case Japan's loss--shown in (6);
- -- the losses after adjustment in column (9) are (1) plus (8);
- -- the losses are also distributed by priority needs in column (10), by dividing the total of (1) by the total of (5), and then by multiplying this result by each element in (5); and

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-- the losses after adjustment in column (11) are one half the sum of (9) and (10).

Example III illustrates a mild crisis, in which each partner's priority needs would be met under the pattern of initial losses:

- -- column (4) is (2) times (3);
- -- column (5) is (2) minus (4);
- -- column (6) is the total of (1) divided by the total of (5), multiplied by each element in (5);
- -- the first loss adjustment column under (7) is
 .5 times (1), and the second loss-adjustment
 is .5 times (6), where the two values of .5 serve
 as weights for columns (6) and (7), and where
 another pair of weights such as .9 and .1 could
 be used; and
- -- the loss after adjustment in column (8) is the sum of the adjustments in column (7).

Example IIIa shows how the solution in Example III would change if in computing loss adjustments under (7) we were to weight the initial solution in (1) by a factor of .85, and the solution in (6) by a factor of .15.

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In summary, the outcome of the vital needs plan depends on:

- -- the initial pattern of losses;
- -- the priority factors; and
- -- the weights used in computing loss adjustment.

Consumption-Based Sharing and Import-Based Sharing

The next table illustrates two plans, namely consumption-based sharing and import-based sharing.

Columns (1), (2), (3), (4), and (5) apply in both cases.

- -- column (1) lists normal imports, and (2) lists each bloc's share of total imports;
- -- column (3) lists normal consumption, and (4) lists each bloc's share of total consumption; and
- -- column (5) lists the loss in imports that each bloc experiences six months after the start of the crisis.

Under consumption-based sharing, each partner takes the same percentage cut in consumption:

-- the losses in consumption in column (9) are derived by multiplying each percentage in (4) times the total of (5); and

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Table 3

Import-based Sharing and Consumption-based Sharing Under a Total Arab Embargo of the U.S. and a Five Percent Reduction Per Month in Arab Experts to Western Europe and Japan After

1 November 1973
(All quantities in millions of barrels per day unless otherwise stated.)

	(1)		(3) il Flows	(4)	(5)	(6) 4m7.	(7) ort Shari	(8) Ing		(10) ption Shar	(11)
	Imports	Percent of total Imports	Consump- tion	Percent of Total Con- sumption		Loss in Imports	Imports	Consump- tion	Loss in Consump- tion	Imports	Consump- tion
United States Western Europe Japan	6.5 15.3 5.6	23.7 55.8 20.4	17.5 15.7 5.6	45.1 40.1 14.4	1.8 4.2 1.3	1.7 4.1 1.5	4.8 11.2 4.1	15.8 11.6 4.1	3.3 3.0 1.0	3.2 12.3 4.6	14.2 12.7 4.6
Total					7.3	<u>7.3</u>			7.3		

-- the levels of consumption implied by the plan, namely values in column (11), are derived by subtracting (9) from (3).

Under import-based sharing, each partner takes an equal percentage cut in imports:

- -- the losses in column (6) are derived by multiplying each percentage in (2) by the total of (5);
- -- the imports after sharing, in column (7), result from subtracting (6) from (1); and
- -- levels of consumption after sharing, in column (8), are derived by subtracting (6) from (3).

An Arithmetic Mixing of Oil Consumption Sharing and Oil Import Sharing

During any crisis, import-based sharing dictates one set of shares of available imports (as in column (7) of table 3), and consumption-based sharing dictates another set of shares of imports (as in column (10) of table 3). To compromise between these two plans, we could weight the import-based solution by 50%, and the consumption-based solution by 50%. Mechanically, this would amount to:

- -- multiplying each import level in columns (7) and (10) of table 3 by .5, thereby getting two new columns, with the first number in each pertaining to the US, the second to Western Europe, etc.; and
- -- adding the corresponding elements of each new column in order to get a third new column, namely the imports resulting from the 50/50 compromise.

The weights need not be 50% and 50%. The importbased shares could be weighted by 90% (e.g., by multiplying .9 times each element in column (7) of table 3), and the

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consumption based shares could be weighted by 10%. Any pair of positive percentages that add to 100% could serve as weights.

A Combination of Import Sharing, Essential Needs Sharing, and Oil Consumption Sharing

This combined plan consists of three distinct options for sharing, namely sharing on the basis of imports, of consumption, and of vital needs. Each of the three is explained above in this annex.

To determine which of the three would apply in a particular crisis, we examine the loss each partner country would suffer under an agreement to share on the basis of imports.

By definition, a mild crisis obtains when under an import-based agreement each partner suffers less than a 10% cut in consumption. During a mild crisis, the combined plan reduces to import-based sharing. Table 4 illustrates this in a particular case:

- -- column (1) shows initial losses;
- -- columns (2) and (3) show pre-crisis levels of consumption and imports; and

Table 4

Sample Applications of a Combination of Import Sharing,
Essential Needs Sharing, and Oil Consumption Sharing
(All quantities are in millions of barrels per day unless stated otherwise.)

Example I--A Mild Crisis

			-manga d	422				
	(1) Initial Lossos	(2) Pru-crisis Consump- tion	(3) Pre-crisis Imports	(4) Percentages of Total Imports	(5) Percentages of Total Consumption	(6) Essential Needs	(7) Import-based Consumption Levels	(8) Consumption Levels During Crisis
United States Western Europe Japan	1.0 .5 .4	17.5 15.7 5.6	6.5 15.3 5.6	24 56 20	Not Applicable	15.75 14.13 5.04	17.05 14.64 5.21	17.05 14.64 5.21
600 600 27.0			Example II	A Moderate C	risis			
Western Europe Japan	1.8 1.1 .9	17.5 15.7 5.6	6.5 15.3 5.6	24 56 20	Not Applicable	15.75 14.13 5.04 34.92	16.60 13.58 4.82 35.00	15.83 14.13 · 5.04
desires desires Timbe	•		Example I	IIA Severe C	risis	•		•
United States Western Europe Japan	1.8 4.2 1.3	17.5 15.7 5.6	Not Applicable	Not Applicable	45 41 14	15.75 14.13 5.04	15.8 11.6 4.1	14.2 12.7 4.6

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-- percentages in column (4) are derived by dividing the total of (3) into each element of (3).

Given the information in columns (1) - (4), we proceed to compute values for columns (6) and (7):

- -- column (6) is derived by multiplying an arbitrary factor, in this case .9, times each element in (2), such that the results are "essential needs" for each partner; and
- -- column (7) is derived by multiplying each percentage in (4) times the total of losses in (1), in order to distribute the total loss over partners, and then by subtracting the losses from consumption levels in (2).

Since in the first example of table 4 each essential need in column (6) is less than the corresponding level of consumption in column (7), then the crisis is mild and the final solution is sharing on the basis of imports, as in column (8).

In the second example we proceed exactly as in the first example in order to calculate essential needs in column (6) and import-based consumption levels in column (7). In this case, the essential needs of Western Europe and Japan are not met under import-based sharing, although the partners' total consumption exceeds their total vital needs. Thus by definition the crisis is moderate. In all moderate crises, the import-based solution in column (7) is adjusted so that all partners' essential needs are met, as in column (8).

In the third example we proceed as in the first two to compute columns (6) and /). In this case the total essential needs exceed the total level of consumption possible during the crisis, so the crisis is termed severe. In all severe crisis, oil is allocated on the basis of consumption, as shown in column (8).

Sharing on an Import Basis, but with Limits on Cuts in Consumption

Under consumption-based sharing, all partners always take equal percentage cuts in consumption, while under import-based sharing the partners do not. To share on an import basis, but to limit the disparity of percentage cuts in consumption, we begin with three arrays of numbers, namely the initial losses, the pre-crisis levels of consumption, and the pre-crisis imports, as in columns (1), (2), and (3) of table 5.

From these arrays we compute import-based consumption levels and consumption-based consumption levels, as explained above in this annex, and as illustrated in columns (4) and (5) of table 5. We then multiply each import-based level by .99, and each consumption-based level by (1-.99), or .01. These multiplications yield two sets of levels, namely the import-based levels weighted by .99, and the consumption-based levels weighted by .99, and the consumption-based levels weighted by .01. We add corresponding elements of the two sets to get a single compromise solution. In this case, the compromise is heavily biased toward the import-based solution.

Table 5

An Example of Sharing on an Import Basis, but with Limits on Cuts in Consumption (All quantities in millions of barrels per day unless otherwise stated.)

	(1) Losses Under No Sharing	(2) Pre-Crisis Consumption	(3) Pre-Crisis Imports	(4) Import-based Consumption Levels	(5) Consumption-based Consumption Levels	(6) Weighted Solution for Consumption Levels*	(7) Weighted Solution for Consumption Levels **
United State:		17.5	6.5	15.77	14.21	15.60	14.66
Western Euro		15.7	15.3	11.62	12.75	11.75	12.42
Japan		5.6	5.6	4.11	4.55	4.16	4.42

No partner's percentage cut in consumption exceeds another's cut by more than 15 percentage points.

No partner's percentage cut in consumption exceeds another's cut by more than five percentage points.

The compromise implies a set of percentage cuts in consumption, one for each partner country. There may be great disparities among the percentage cuts in consumption. If we want to insure that no partner's percentage cut in consumption exceeds another's by more than 15 percentage points, we calculate a new compromise. In this case the import-based solution is weighted by .98 rather than .99, and the consumption-based solution is weighted by .02 rather than .01. If the compromise obtained by adding the two weighted solutions satisfies the condition that no percentage cut should exceed another by more than 15 points, then the compromise is final.

If the 15-point condition is not satisfied, we again revise the weights, this time to values of .97 and .03. We then compute a new compromise based on these weights, and determine whether the new solution meets the 15-point condition. If so, the compromise is final; and if not, we choose new weights of .96 and .04. Again we compute a compromise and then test it against the 15-point limit. We continue this process until the limit is just satisfied (see the solution in column (6) of table 5).

The same procedure applies for any agreed limit on the disparity of percentage cuts in consumption. The smaller the allowable disparity, the closer to consumption-based sharing will be the final solution (see column (7) of table 5).

Sample Effects of Alternative Sharing Plans Under Different Crises

Each of the six sharing plans illustrated above implies different shares in different crises. Samples of these different effects appear in tables 6 and 7.

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									(111	ions of Far	rein Per Day)
		Normal Oil Flows			Libyan Embargo of US Only		Saudi Production Limited to 8.5 Million B/D		Libyan Embargo of US & Western Europa		ab Lubaigo E US, Western Durce
19	75	Invorts	Consumption	Inports	Consumition	Inports	Consumption	Invorts	Constantion	Irrorts	Confurtion
Consumption Sharing	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.9 15.9 6.6	18.9 16.9 6.6	7.7 15.8 6.5	18.7 16.8 6.5	6.8 15.0 6.2	17.8 16.0 6.2	0.2 9.1 3.9	11.2 10.1 3.9
Import Sharing	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.9 15.9 6.6	18.9 16.9 6.6	7.8 15.7 6.5	18.8 16.7 6.5	7.3 14.7 6.0	18.3 15.7 6.0	3.5 6.9 2.8	14.5 7.9 2.8
Vital Necds Sharing I*	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.85 15.95 6.6	18.85 16.95 6.6	7.8 15.7 6.5	18.8 16.7 6.5	7.2 14.3 6.5	10.2 15.3 6.5	0 8.8 4.4	11.0 9.8 4.4
Vital Needs Sharing II*	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.05 15.95 6.6	18.85 16.95 6.6	7.8 15.7 6.5	18.8 16.7 6.5	7.2 14.3 6.5	18.2 15.3 6.5	0 B.P. 4.4	9.8 4.4
No Sharing Combination	United States Western Europe Japan	6.6 8.0	19.0 17.0 6.6	7.8 16.0 6.6	18.8 17.0 6.6	7.8 .15.7 6.5	18.8 16.7 6.5	7.8 13.6 6.6	18.8 14.6 6.6	4.6 4.8 3.8	15.6 5.8 3.8
of Import Sharing, "stential Aceda Shar- ing, and Oil Consumption Sharing	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.9 15.9 6.6	18.9 16.9 6.6	7.8 15.7 6.5	18.8 16.7 6.5	7.3 14.7 6.0	18.3 15.7 6.0	.2 9.1 3.9	11.2 10.1 3.9
Limits on Cuts in Consumption **	United States Western Europe Japan	8.0 16.0 6.6	19.0 17.0 6.6	7.9 15.9 6.6	18.9 16.9 6.6	7.8 15.7 6.5	18.8 16.7 6.5	7.3 14.7 6.0	18.3 15.7 6.0	1.0 8.7 3.5	12.0 9.7 3.5

^{*} On the basis of our understanding of the French position as presented in the paper Schéma de Réportition des Importations de Pétrole Prut of the Ministry of Industrial and Scientific Development. Vital Needs Sharing II is the same as Vital Needs Sharing I except that the US share of private transport considered vital is raised from 501 to 851.

^{**} Import sharing used as a basic scheme, and no bloc's consumption cut is 10% greater than the cut of another bloc.

Table 7

Allocations of Available Oil Under Alternative Criteria for Sharing (Millions of Barrels Per Day)

				1973			
		•			A Hypothetical Scenario Evaluated After Six Months*		
Option/Block		Normal Imports	Oil Flows Consumption		Imports After Sharing	Consumption After Sharing	
Oil Consumption Sharing	United States Western Europe Japan	6.5 15.3 5.6	17.5 15.7 5.6	•	3.2 12.3 4.6	14.2 12.7 4.6	
Oil Import Sharing	United States Western Europe Japan	6.5 15.3 5.6	17.5 15.7 5.6		4.8 11.2 4.1	15.8 11.6 4.1	
Vital Needs Sharing	United States Western Europo Japan	6.5 15.3 5.6	17.5 15.7 5.6		3.4 11.9 4.8	14.4 12.3 4.8	
Combination of Import Sharing, Essential Needs Sharing, and Oil Consumption Sharing	United States Western Europe Japan	6.5 15.3 5.6	17.5 15.7 5.6	•	3.2 12.3 4.6	14.2 12.7 4.6	
Limits on Cuts in Consumption**	United States Western Europe Japan	6.5 15.3 5.6	17.5 15.7 5.6		4.8 11.2 4.1	15.8 11.6 4.1	

^{*} The Hypothetical Scenario is a total Arab embargo of the United States, and a 5 percent reduction per month in Arab exports to Western Europe and Japan after 1 November 1973.

^{**} Import sharing used as a basic scheme, and no bloc's consumption cut is 20% greater than the cut of another bloc.